

## CHAPTER 9 HEALTH PROTECTION

The American environment today contains health hazards with the potential to kill, injure and disable individuals and substantially affect the health of entire communities.

Some estimates hold that perhaps 20 percent of all premature deaths--and a vast amount of disease and disability--could be eliminated by protecting our people from environmental hazards.

We have seen past improvements in protection--through better sanitation, better housing, better water--contribute greatly to the increased life expectancy of the last 80 years.

But, during this same period, rapid industrial and technological development, social changes, and a larger United States population, concentrated increasingly in urban areas, have increased the complexities of maintaining a healthy and safe physical environment.

Nevertheless, measures are available to communities to provide better health protection.

Many communities and States have begun to develop health and safety standards to protect their citizens. And Federal laws and Executive Branch initiatives during the past 15 years have created an extensive Federal regulatory effort to help them.\*

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\* Health protection responsibilities are presently distributed among several Federal regulatory and research organizations: the Environmental Protection Agency; the Department of Labor's Occupational

This chapter is concerned with five areas in which National, State and local efforts can significantly improve health and the quality of life for this and future generations of Americans: toxic agent control, occupational safety and health, accidental injury control, fluoridation of community water supplies, and infectious agent control.

### Toxic Agent Control

Toxic factors in today's environment present formidable challenges.

During a lifetime, people are exposed, often unwittingly, to hazards from many sources.

Although how all of these hazards interact is not known, for some it is known that their destructive potential can increase markedly when people are exposed to more than one.

### Exposure Sources

Many of the agents posing new threats to American health are chemicals developed for industrial and agricultural purposes.

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Safety and Health Administration; the Nuclear Regulatory Commission; the Consumer Product Safety Commission; the Department of Transportation's National Highway Traffic Safety Administration; the Department of Treasury's Bureau of Alcohol, Tobacco and Firearms; the Department of Agriculture's Food Safety and Quality Service; and the Department of Health, Education and Welfare's Food and Drug Administration, Center for Disease Control, National Institute for Occupational Safety and Health, National Institute of Environmental Health Sciences, and National Cancer Institute.

The growth of synthetic chemicals in the last 25 years has been extraordinary: more than four million chemical compounds are now recognized; more than 60,000 are commercially produced; about 1,000 new ones are introduced each year.

Some make their way into water and food supplies. While there are now substantially fewer dangers from contamination of drinking water by bacteria, the dangers of contamination by oil, fuel and organic chemicals are very real.

With the growth in use of chemicals for industry and farming, the Nation's waterways have become vulnerable dumping grounds for wastes from these uses. Food supplies as well are subject to contamination or treatment with chemicals in the course of growth, fertilizing, harvesting, processing and storage.

The dangers are demonstrated by recent incidents involving Kepone, polychlorinated biphenyls (PCBs), and polybrominated biphenyls (PBBs).

The insecticide Kepone, discharged from the Virginia plant in which it was manufactured, contaminated edible fish as it spread in unknown quantities to the James River, Chesapeake Bay, and the Atlantic Ocean. It caused serious neurologic and reproductive effects in workers exposed to it--and, in experimental animals, has caused cancer as well. It is no longer manufactured.

PCBs have been produced in huge quantities for use as plasticizers and insulation for electrical equipment. Not until tens of millions of pounds were produced and released into the environment was there any realization of how toxic and persistent these substances are.

Despite limited restrictions imposed in the early 1970s by industry to reduce production and use, high PCB levels continue to persist in the

Great Lakes and other major waters across the nation. In the past few years, PCBs have been found in tissues of humans and in the milk of nursing mothers. When fed experimentally to nursing monkeys, PCBs have led to serious injury of offspring.

Similarly, in 1973, the accidental mixing of the fire retardant polybrominated biphenyl in cattle feed resulted in contamination of food and livestock throughout Michigan. Growth deformities occurred in many of the cattle; thousands had to be destroyed. The health effects on the population which consumed contaminated food are still under study, but large numbers of people have been found to have elevated levels of PBB in their bodies.

Air pollution is another major source of hazard.

About 80 percent of Americans now live in urban areas where toxic gases or particulate matter pollute the air. Most of the pollution results from combustion of fossil fuels by automobiles and in industrial activities.

Four groups of air pollutants are of major concern: sulfur oxides, including sulfur dioxide ( $\text{SO}_2$ ) and sulfur-containing aerosols; carbon monoxide; photochemical oxidants, particularly ozone; and nitrogen oxides such as  $\text{NO}_2$ ,  $\text{NO}$  and nitrite aerosols.

Increased air pollution has been associated with debilitating respiratory diseases such as acute and chronic bronchitis and pneumonia, and exacerbation of symptoms in people who already have pulmonary disease. Of concern, too, are poisoning from lead emitted to the air and the possibility of cancer from pollutants such as asbestos, beryllium, benzene, and other synthetic organic chemicals with carcinogenic potential.

Chemicals can be hazardous not only during their manufacture, formulation and use, but also during

transportation and disposal. Community-wide exposures have resulted from accidents during movement of large volumes of chemicals across land and waterways.

And exposure problems are exacerbated by many community waste disposal sites containing large quantities of unknown chemical products. Many of these sites have been in use since the mid-1940s and their deposits may include highly toxic materials that can contaminate surface or ground water supplies or the atmosphere itself.

Leakage of chemicals from the Love Canal site in upstate New York reveals the risks to public health from chemical wastes disposed of before the initiation of regulatory controls. As chemicals began to leak out of the land-filled canal, concern arose about exposure for residents of homes built on the site. More than 80 different compounds have been identified, 11 of them known or suspected carcinogens. There has been a significantly higher rate of spontaneous abortions among exposed women. An association with congenital abnormalities is also suspected.

Several thousand such disposal sites exist throughout the country and close monitoring is needed to safeguard against harmful exposures.

Radiation is another environmental source of human illness. About half of all ionizing radiation to which the general population is exposed comes from naturally occurring radioactive materials in the water, soil and air. Another 45 percent is from medical and dental use of x-rays and from radioactive materials used for diagnosis and treatment. The remaining five percent comes from fallout, industrial uses, production of nuclear power, and consumer products.

Ionizing radiation from nuclear energy and medical diagnosis and treatment can, if there is exposure to large enough doses, cause cancer, genetic

defects, and tissue injury. The entire population is also at potential risk as the cumulative dose of exposure to low-level ionizing radiation grows. Non-ionizing radiation, such as from ultraviolet rays and microwaves, carries lesser risk with single exposure, but the possibility of harmful effects is increased because total potential exposure is large.

#### Health Effects

It takes at least 20 years to determine full effects of many new compounds on human health--and health problems caused by some compounds in use today may not be known until the 21st century.

But it is clear that toxic compounds can have diverse, serious effects. They are capable of producing reproductive and developmental impairments, mutagenesis, cancer, chronic degenerative diseases, neurologic and behavioral impairments, and immunologic diseases.

Evidence for such capability comes from the experience of occupational groups exposed to greater chemical or physical hazards than those to which the general population is exposed. If high exposure causes serious disease, the same ill effects may occur in people exposed to much lower doses over a long period. For example, a single intense exposure to nuclear radiation produced very high rates of certain cancers and other illnesses among the populations of Hiroshima and Nagasaki, but radiation in much smaller doses also causes cancer over time in susceptible individuals.

Because successful reproduction and development are essential to healthy propagation of the species, agents that affect reproductive capacity or fetal development are of concern. Recent data show, for example, that men exposed to toxic agricultural chemicals such as Kepone and dibromochloropropane are at greater risk for impotence and infertility. In addition, more than 20 agents are known to be associated with human birth defects and many times that number cause birth defects in laboratory animals.

Of possibly even greater concern is the potential occurrence of mutations from exposure to environmental agents. A mutation--a change in the genetic material of a cell--can alter biologic development. If a mutation involves non-sex cells or is so drastic as to be lethal, effects are confined to a single generation. But if the mutation involves egg or sperm cells of either parents or fetus, the effects can be passed along indefinitely from generation to generation.

Probably the most widely discussed effect of hazardous substances is cancer. Statements that up to 90 percent of human cancers are due to environmental factors have received much attention but these estimates include as environmental sources such factors as diet, alcohol, and cigarette smoking.

Nevertheless, there are substantial threats from chemicals and radiation. The National Cancer Institute currently lists at least 20 chemicals and compounds for which there is epidemiological evidence of human cancer causation. Among them are asbestos, benzene, vinyl chloride, and arsenic. In addition, over 2,300 specific chemicals are suspected carcinogens, including some insecticides, herbicides, asphalt fumes, wood dust, and coal tar volatiles. They are believed to work through varied mechanisms.

Some produce mutations in the genetic material of cells which then reproduce unchecked; others may suppress the immune mechanism which usually destroys tumor cells; and others may stimulate the proliferation of tumor cells themselves. More than one mechanism may work at one time; the effects of exposure to single agents may be additive; and concurrent exposure to multiple agents may be more hazardous than the sum of the individual exposures.

In addition to cancer, environmental agents can cause other degenerative diseases, including arteriosclerosis, heart disease, hypertension, emphysema, chronic bronchitis, kidney disease, liver disease, diabetes, anemia, neurologic and behavioral disorders, and immunologic diseases.

There is virtually no major chronic disease to which environmental factors do not contribute, directly or indirectly. Some of the most striking effects noted to date have been the neurologic and behavioral problems of workers exposed to certain pesticides, organic solvents, and inorganic metals.

#### Detection and Control

Protection against toxic environmental agents depends upon reliable methods of identifying hazards to health. Clinical and epidemiologic research has helped recognize harmful substances by finding unusually high rates of disease occurrence in certain population groups with unique exposure histories.

But disease generally occurs after a long latent period during which large numbers of people may be exposed to what will turn out to be the hazardous agent. Methods are needed to demonstrate biologic changes with potential for leading to disease--before disease actually occurs.

Animal studies provide one such method. With one or two possible exceptions, all agents known to produce human cancer also produce cancer in experimental animals. There is a popular misconception that under laboratory conditions any compound can cause cancer in animals. A study conducted for the National Cancer Institute found, however, that fewer than 10 percent of 120 common pesticides caused more tumors than expected when fed continuously to mice in high doses for 18 months, beginning in infancy.

Actually, animal studies have more often proved prophetic than not. That estrogen replacement therapy for women would increase risk of uterine and, possibly, breast cancer was predicted accurately by studies on several species of animals in the 1930s. Studies on quail in 1964 showed that Kepone could cause reproductive failure and nervous system disease. And studies on rats indicated that vinyl chloride gas would prove to be carcinogenic in the industrial setting.



A principal drawback to current animal testing procedures is the time and expense they require. A complete animal test of any suspected substance can take upwards of three years and cost several hundred thousand dollars. Several billion dollars would be needed to fully test the backlog of organic chemicals now in the environment but still untested.

Fortunately, encouraging progress is being made in developing rapid, less expensive tests for carcinogenicity and mutagenicity. Such approaches are designed to observe the short-term effects of toxic agents at the cellular or biochemical level.

They include tests for mutagenesis in mammalian cells, insects, and microorganisms; identification of any damage to or repair of DNA; malignant transformation of cells in culture; and chemical reactivity of activated substances. The rapid procedures can be used to screen large numbers of suspected toxic agents to determine which to subject to more intensive animal studies.

When it comes to implementing measures to improve the quality of the environment, the challenge falls to all sectors of our society--individuals, health professionals, private industry, community groups, and government.

At the Federal level, several departments and agencies, noted earlier, conduct programs to identify, monitor, evaluate, and control harmful environmental contaminants.

Although these programs appear to have broad public support, their economic and technological impact can be substantial, and they are an increasingly common subject of debate inside and outside government.

Nevertheless, it is clear that the Federal government must continue to bear major responsibility for setting and enforcing pollution standards and for dealing with health risks related to environmental contamination. A strong emphasis on

refinement of tests which can help identify potential new hazards is especially important.

State and municipal governments can reduce environmental hazards by monitoring the safety of air and drinking water; controlling use of ionizing radiation; providing adequate sewage disposal; requiring auto safety and emission inspections; and regulating the use of pesticides and other agricultural chemicals.

At the local level, individuals, community groups, and government agencies, including public health departments and health planning bodies (health systems agencies), can identify health hazards unique to a particular community. Easily observable effects on chronic diseases may on occasion be detected by community surveillance. Local education programs can help inform people about the hazards of toxic agents in the environment and how to protect themselves against them.

Although some significant environmental reforms have been achieved in recent years and the Nation's air and water are cleaner, environmental programs are frequently challenged and need stronger support.

Part of the problem in controlling environmental hazards is that they are produced as individuals or industries pursue diverse activities which have become parts of our daily lives. The automobile, electric power generation, plastics manufacture, and construction are all integral parts of present lifestyles and the economy--and all pose health and safety hazards.

The challenge is to reduce the hazards without undue sacrifice. But some changes in lifestyle may be necessary. Reduced use of automobiles is one. Eliminating waste in the use of energy is another. Reducing consumer demand is a third, and recycling is a fourth.

Because of the strength of competing interests, health does not always emerge as the top priority.

But achievements of the past few years indicate that, notwithstanding obstacles, environmental changes can produce substantial health benefits.

### Occupational Safety and Health

There are more than 97 million American workers--many of them exposed to some kind of occupational health hazard: carcinogenic agents, pulmonary or other physical disease incitant, or job-related pressures of noise, crowding, stress or boredom which can have adverse psychological effects.

Each year 100,000 Americans die from occupational illnesses and almost 400,000 new cases of occupational disease are recognized, according to National Institute for Occupational Safety and Health estimates. And the actual extent of occupational disease is probably much greater because the link between job and disease is often unrecognized or unreported.

Occupational exposures to toxic chemicals--as well as such physical hazards as excessive noise, radiation, sunlight and vibration--can produce chronic lung disease, cancer, degenerative disease in a number of vital organ systems, birth defects, and genetic changes that may be transmitted to future generations. Some hazards also increase frequency of stillbirths, spontaneous abortions, reduced fertility, and sterility.

These health effects are often linked with particular jobs. For example, workers engaged in manufacturing the pesticide dibromochloropropane have experienced an infertility rate twice to three times as great as for the general population. Examples of job exposure to carcinogens are noted in Chapter 6. Of nearly 34,000 chemicals in the workplace which have reported toxic effects, over 2,000 have been reported to be potential human carcinogens.

Yet, despite risks of serious disease or injury, most workers are unprotected. Worksite exposure standards have been established for only a few toxic substances.

Nine of every 10 American industrial workers are not adequately protected from exposure to at least one of the 163 most common hazardous industrial chemicals, according to a recent occupational hazard survey.

And now under careful review is a recent estimate that, if the full consequences of both present and recent past occupational exposures are taken into account, perhaps 20 percent of all cancers may be related to carcinogens encountered in the workplace.

Not all occupational hazards are found in factories or exposure to toxic substances. Work-related injuries kill about 13,000 Americans each year and affect nine million more so severely that they require medical care or are at least temporarily unable to work.

People in mining, agriculture (including forestry and fishing), and construction are six, three, and three times respectively, more likely to die from a work-related injury than other private sector workers. And work-related problems are reported by a wide variety of employee groups, including medical technicians, cosmetologists, flight attendants, dentists, air traffic controllers, and many others.

#### Health Protection Measures

Occupational hazards can be controlled by modifying work environments, patterns of job performance, or both.

Altering the work environment--plant, processes, materials used--is the most effective. Protection against hazards can be facilitated by requiring appropriate engineering controls, particularly as new plants are built.

For success, prevention strategies must rely heavily on employer efforts and support from employees, unions, and government regulatory bodies.

Worker protection may also require special protective equipment when other means are unavailable--and careful monitoring of workers exposed to hazards in order to ensure that safety controls are effective. Sometimes, however, conditions and circumstances hamper efforts to protect workers. Personal protective equipment, for example, often is uncomfortable and encumbering.

Effective protection also depends on the design and maintenance of equipment and proper training of employees.

It must be recognized that higher pay for hazardous jobs may lead employees to choose immediate financial benefit over long-term safety and health protection. And the concentration of industries with hazardous conditions in certain geographic areas, or their location in otherwise economically depressed communities, or their presence as the only industry in a community gives workers, in effect, no opportunity to choose a safer job.

Furthermore, development of hazard control technology has lagged behind the growth in industrial use of hazardous chemicals and sources of physical energy such as microwaves, nuclear energy, lasers, and ultrasound.

Even when controls are available, there are few incentives for employers to install or maintain them. Positive incentives that could be provided include low-cost loans, tax benefits, and technical assistance. Regulation is a negative incentive but occupational safety standards, important to preserving the health of millions of workers, should be strongly and consistently enforced.

It was recognition of the increasingly compelling importance of assuring worker protection that led to passage in 1970 of the Occupational Safety and Health Act.

The Act established the Occupational Safety and Health Administration (OSHA) in the Department of

Labor, with responsibility for mandating and enforcing health and safety standards for the workplace and for educating workers about potential hazards. Scientific support for the Administration's work is provided by the Department of Health, Education and Welfare's National Institute for Occupational Safety and Health.

Pressures on OSHA are often conflicting, with some groups urging fewer and less restrictive standards and others requesting faster and more aggressive action. Clearly, enforcement of the Act, especially for workers facing significant health hazards--asbestos workers, textile workers, chemical workers, and many others--deserves high national priority.

#### Health Promotion Measures

Many firms and some government agencies have taken steps to provide worksite programs for promoting health through health education, physical fitness activities, and preventive medicine. Some provide screening for hypertension, high blood cholesterol, and heart disease. Some conduct or refer employees to groups to help them stop smoking or lose weight.

Encouraging results have come from a number of programs, and indicate the utility of establishing these programs for employees from the assembly line to the executive suite.

Some companies have become concerned about stress in and out of the workplace and are instituting measures to help employees deal with its adverse effects. Training in meditation and other relaxation techniques, and seminars on how to cope with stress at home and at work are examples of measures provided by some companies. Many employ company psychologists or psychiatrists, or pay for such services outside the firm. The extent to which such efforts actually reduce stress is still under study.

Beyond helping employees handle the pressures of work, a few firms try to modify the nature of the work. Some redesign jobs and organizational structures to try to make jobs more meaningful and fulfilling. For example, instead of assembly lines which require each worker to deal with smaller and smaller elements of a whole, some employers allow workers to assemble entire products.

Among other experimental measures showing promise are programs that allow workers to work in small face-to-face groups with a good deal of autonomy. The groups may be responsible for a given level of output but decide among themselves how to accomplish their goal, including deciding which hours to work. Supervisors concentrate less on giving detailed orders and more on making sure the groups have the resources they need.

Although they do not solve every problem of occupational stress, such measures have the potential to decrease job dissatisfaction and its costly consequences--absenteeism, employee turnover, alcoholism, waste of materials, sabotage, and plant shutdowns--and presumably thereby increase productivity.

#### Gaps and Needs

Despite increasing research into occupational safety and health, many gaps exist.

Inadequate data make it difficult to determine accurately the extent of occupational health problems and to measure the effectiveness of prevention efforts.

Because of long latency periods before disease develops, knowledge is lacking about the risks of the approximately 1,000 new chemicals introduced each year and how they may interact.

One problem in collecting statistical data about occupational exposures is the variety of ways in which people come in contact with hazardous

agents--by ingestion, inhalation, skin contact, or some combination of these.

Another problem is lack of recorded information about the intensity, duration and combinations of exposures.

The difficulties are compounded by concerns for confidentiality--of employers over trade secrets, and of workers and occupational physicians over personal health records. Often, too, workers are not told the names, particularly the common names, of chemicals with which they work or simply do not know of toxic substances to which they are or were exposed. And when they do know, they may prefer to face possible health risks rather than the prospects of job loss.

Among critical areas that need study are the role of occupational exposures in producing birth defects and the special problems of women exposed to hazardous substances. Others include: occupational causes of respiratory disease, alone or in combination with smoking; the role of job stress and exposure to physical and chemical agents in cardiovascular disease; and the behavioral changes induced by chronic exposure to low levels of chemicals; the health effects of occupational exposure to such physical agents as heat and radiation and the interaction between these and chemical agents; and methods for analyzing thresholds of exposures to hazardous workplace conditions.

Finally, we need to learn what combinations of regulations and incentives work best to bring about changes in both employer and employee attitudes and practices to reduce known occupational risks.

That the work environment can play a major role in compromising health has been known for many decades. It is time now for substantially increased efforts to control known hazards, treat those afflicted, and develop techniques to identify and prevent harm from materials and processes not now recognized as dangerous.



It is time, too, to act on the recognition that the workplace not only should not contribute to physical or mental disease, but is also a legitimate and highly useful place for promoting health.

### Accidental Injury Control

More than 100,000 Americans lost their lives to injuries in 1977--nearly half of them from motor vehicle accidents, the rest from falls, burns, poisonings and other causes. In 1977, too, 65 million people suffered non-fatal accidental injuries, requiring medical treatment--and in terms of damage, injury and lost productivity, the estimated cost of accidents in 1977 was \$62 billion.

The leading cause of death between ages one and 44, accidents account for roughly 50 percent of fatalities for those 15 to 24. But the highest death rate for accidents occurs among the elderly whose risk of fatal injury is nearly double that of adolescents and young adults.

Educational approaches advocating changes in behavior have been generally ineffective in preventing accidents among those at highest risk--young children, teenage males, problem drinkers, and the elderly.

More effective measures involve changing the manmade environment to reduce risk for those unable to take adequate precautions. Such efforts are certainly not unprecedented. Examples include insulated tools, childproof medication containers, lead-free paints, and automobile airbags.

### Motor Vehicle Accidents

Highway accidents in 1977 killed 49,000 people and led to 1,800,000 disabling injuries. The total cost, as estimated by the Department of Transportation was more than \$43 billion.

Teenagers and young adults--the 15 to 24 year olds--have the highest motor vehicle death rate of

any group, accounting for one-third of all motor vehicle deaths.

Like many other types of accidents, motor vehicle crashes traditionally have been blamed on human error, and prevention strategies have consisted primarily of driver education programs. But more recently, injury control experts have identified a range of factors in vehicle collisions which occur with imbalances between the demand of the highway system, the characteristics of individual vehicles, and the age and other characteristics of the driver.

Moreover, it appears that injuries often can be prevented or reduced even when collisions occur. A number of preventive strategies emerge--some aimed at preventing collision, others at minimizing their consequences,

Many collisions obviously can be prevented by reducing vehicle numbers and miles traveled by automobile through encouraging people to travel by air, rail or bus--all safer modes of transportation.

Similarly, lower speed limits, if observed, would reduce both the number and severity of crashes--and, for several years after it was imposed in 1974, the national 55 mph speed limit saved an estimated 4,000 to 5,000 lives each year.

The greatest risk factor for fatal accidents is driver alcohol use. In about 50 percent of drivers involved in fatal crashes, blood alcohol levels have been found to be excessive. Although driver education and strict penalties such as mandatory license suspension have the potential to reduce alcohol-related accidents, those measures have not been very effective to date. Clearly important are the general preventive measures to reduce problem drinking discussed in Chapter 10.

Vehicle design is another major factor in highway injury and death. To reduce crash impact on driver and passengers, automobile bumpers, front

ends, and steering columns can be designed to absorb energy. Passenger compartments can be better designed to withstand accidents, with protruding knobs and handles eliminated and hard surfaces padded. Although some of these design features have been adopted, most cars are not designed to fully protect occupants from injury in crashes that occur at legal let alone high speeds.

Combined lap and shoulder belts can almost halve the likelihood of serious injury or death, and although all passenger vehicles sold in the United States are equipped with seat belts, fewer than 20 percent of drivers use them.

Current Federal law requires that by 1983 all new cars contain devices that automatically protect front seat passengers in frontal collisions. The devices--such as airbags and belts that are automatically positioned when the car door is closed--promise substantial protection. The National Highway Traffic Safety Administration recently reported a fatality rate for one type of car equipped with automatic belts only half that for the same type equipped with conventional safety belts.

If no child died in an automobile accident, the death rate for children could be reduced by fully one-fifth. Now, about 1,000 youngsters under age five die, and more than 50,000 suffer serious injury each year.

A number of devices specially designed for children provide the best protection. Their use should begin with a newborn's trip home from the hospital. In the absence of the special restraints, adult seat belts are better than nothing. Beyond reducing risk of serious injury or death, use of restraints may help ensure that children acquire a lifelong habit of wearing protection.

Yet--in the face of evidence showing their effectiveness--a 1974 survey by the Insurance Institute for Highway Safety found proper restraints in use for only seven percent of almost 9,000 passengers under age 10.

Because efforts to convince most people to use child restraints have not been successful, it is important that passive protection devices be developed with children in mind.

An additional action is suggested by the success that changing school hours to non-rush hours has had in some European countries in helping to reduce automobile-related deaths for children.

The motorcycle helmet has proved to be the most effective device for protecting riders from death or serious injury in a collision. Riders using safety helmets have less than half as many moderate to severe head injuries and three to nine times fewer fatal head injuries.

Although helmets are worn 90 to 99 percent of the time in States which require them, they are used less than 60 percent of the time in States which have repealed such laws.

Motorcyclists often contend that helmet laws infringe on personal liberties--and opponents of mandatory laws argue that since other people usually are not endangered, the individual motorcyclist should be allowed personal responsibility for risk.

But the high costs of disabling and fatal injuries, the burdens on families, and the demands on medical care resources are borne by society as a whole. And society has a legitimate concern for protecting the individual.

In Colorado, Kansas and South Dakota--states for which pre- and post-repeal crash data are available--head injuries rose and fatal head injuries doubled after helmet laws were repealed.

The interstate highway system has achieved a halving of death rates compared to all other roads by eliminating crash-precipitating features such as sharp curves, steep grades, blind intersections, uncontrolled access, and lack of physical separation between opposing traffic lanes.

Other measures for preventing death and injury include removing fixed objects or shielding such structures as bridge abutments with energy-absorbing barriers, locating essential signs and poles at sufficient distance from traffic, and designing guardrails to guide vehicles away from hazards.

The importance of these measures is underlined by the fact that almost half of all motor vehicle deaths involve only one vehicle.

#### Firearms

Second only to motor vehicles as a cause of fatal injury, firearms in 1977 claimed some 32,000 lives. About 13,000 deaths were homicides; 2,000 resulted from firearm accidents; 16,000 people took their own lives with firearms; the remaining 1,000 deaths were of undetermined cause. Estimates of non-fatal firearm injuries--many of them permanently disabling--range from 18,000 to more than 100,000.

Although homicides committed with firearms have recently declined after a 10-year period during which the rate doubled, FBI statistics show that in 1976 firearms were used in about 63 percent of homicides, almost half of which were committed with handguns.

Meanwhile, firearm suicides have risen, increasing by 25 percent between 1970 and 1976, while suicides by other methods increased three percent.

Measures that could reduce risk of firearm deaths and injuries range from encouraging safer storage and use to a ban on private ownership.

Evidence from England suggests that prohibiting possession of handguns would reduce the number of deaths and injuries, particularly those unrelated to criminal assaults. Both assaults and suicide attempts are less likely to be fatal without firearms--and firearm accidents would decrease.

About 20 percent of American households contain a handgun. Even if reducing handgun availability did not substantially reduce the number of murders committed during violent crimes, it would likely reduce both accidental deaths and murders of passion involving family members and acquaintances.

For those who feel compelled to keep handguns, certain safety measures can be useful--security locks, use of non-lethal (wax) bullets, and weapon storage in a location separate from ammunition and inaccessible to children.

### Falls

Fifteen thousand Americans are killed and about 14 million are injured each year by falls.

Fatal falls occur primarily in the home but are also a prominent cause of work-injury deaths, especially among construction workers. People over age 75 account for about 60 percent of the deaths resulting from falls and an even greater proportion of the hospital days and disability.

Preventing such deaths and injuries requires preventing the falls themselves by attention to safer walking surfaces and footgear, better illumination, handrails, and window guards--or reducing the potential for injury by minimizing the distances people fall (lower beds for the elderly) or modifying the surfaces they fall against (softer floors, rounded edges and corners on furniture).

Substantial reductions in injuries from falls can be achieved through elementary and inexpensive changes in housing and furniture design.

### Burns

Each year more than a million Americans are burned, 60,000 severely enough to require hospitalization. About 5,000 deaths result from fires--predominantly house fires--and an additional 2,500 are from other burns such as electrical and scalds.

Fifty-six percent of fatal residential fires--and a substantial number of burn injuries--are cigarette-related, often due to smoking in bed. Even in the non-fatal incidents, the consequences are often tragic: painful recovery, disfigurement, and disability.

Many deaths and injuries from residential fires could be prevented through a number of measures: effective fire or smoke detection systems; less flammable furnishings and structural materials; buildings designed for ease of escape; developing and practicing fire evacuation procedures; and less smoking.

Deaths and injuries from ignited clothing have been greatly reduced in the past decade, partly through changes in fabrics and styles, but the problem still warrants attention. Other preventive measures are available but seldom used: matches that burn with less heat and go out when dropped, and fabrics whose weave, finish, composition or chemical treatment makes them less likely to ignite, melt or burn.

Scalds which cause about 40 percent of hospital admissions for burns, often occur in showers and bathtubs. They could be prevented if water heaters in homes, nursing homes, dormitories, and hotels were modified with automated cut-offs so water temperatures remain below those likely to scald.

A recent study for the Consumer Product Safety Commission indicates that this approach, even though it requires larger hot water storage facilities, saves both money and energy.

### Poisoning

Once a leading cause of death for young children, poisoning has decreased significantly as paint lead content has been reduced and drugs and household products have been packaged in childproof containers.

Of 4,000 fatal poisonings in 1977, less than one percent involved children under five. Even as the number of children increased between 1968 and 1976, childhood deaths from poisoning dropped from 284 in 1968 to 105 in 1976.

Still, some two million ingestions of potentially dangerous substances by American children come to the attention of health professionals every year.

Poison Control Centers, now active in a number of localities, provide immediate information on poison antidotes and other emergency measures. Helpful precautionary measures include storing toxic substances separately from food supplies, ensuring that safety caps are fastened, and refraining from introducing medicine to children as "candy."

Currently, treatment of lead poisoning makes use of chemicals that bind to the metal in the body and help in its removal.

But more important is primary prevention of potentially lethal lead poisoning by removal of airborne lead from the environment and rehabilitation of old housing with lead-free paint. Public health screening of high-risk children is important to prevention of adverse health effects, since lead poisoning is usually asymptomatic.

#### Drug Reactions

Some 70,000 prescription drugs (with 2,000 individual ingredients) are now on the market, along with 200,000 over-the-counter preparations. Each year 15 to 20 new chemical entities are introduced. In 1977, 1.4 billion prescriptions were filled at a cost of about \$8 billion.

Adverse reactions--ranging from moderate rashes or nausea to birth defects or death--can occur with almost any drug. For some drugs, reactions are frequent enough to warrant warning labels.



The potential for adverse reactions, coupled with the volume and frequency of drug use, requires the Food and Drug Administration to oversee regular premarket screening and testing for user protection.

#### Product-Related Accidents

A broad range of consumer products used at home or in the workplace can cause injury, either because of faulty construction or inappropriate and careless use.

In 1976, product-related accidents caused about 30,000 deaths and 37 million injuries, according to Consumer Product Safety Commission estimates.

Among the leading causes of injuries were glass, bicycles, skateboards, nails, knives, playground equipment, furniture, and construction and flooring materials.

Measures to reduce injuries and deaths can start with product design and engineering standards--and the education of those developing the designs and standards. They can include improved construction and packaging; testing and development of protective devices; inspection procedures to ensure safety prior to marketing or operation; and better instruction of operators of machinery as well as more complete and clear information provided for consumers and users.

Because unsafe toys, electrical devices, and home swimming pools injure many children, toys with sharp edges or small and swallowable parts should be discarded, electrical outlets should be covered, and swimming pools fenced.

Increased protection for children requires better surveillance of injuries so their causes can be clearly understood and preventive measures applied. It also requires teaching safe behavior and providing barriers that separate children from as many hazards as possible.

## Recreational Accidents

The population at risk for recreational accidents has grown steadily as the amount of leisure time available to Americans has increased.

According to the National Safety Council, accidents other than motor vehicle, work and home accidents caused approximately 21,500 deaths in 1976, with most occurring in recreational or leisure settings.

Disabling injuries in that year numbered some 2,700,000 and about 100,000 sports team injuries were serious enough to require medical attention. Some 7,000 drownings also occur each year, mostly during water sports such as swimming and boating.

Safety measures can help. Children can be taught to float and swim at early age and should learn water safety measures. Adults can avoid water sports when intoxicated (in almost one-third of adult drownings, there are high blood levels of alcohol). Young people participating in team sports can be taught safety measures and ways to prevent injuries as part of their training. Better protective equipment can be developed. Football helmets, for example, which caused 12 percent of all injuries sustained by 9,000 high school players, should be designed to reduce injuries to other players.

Modification of surroundings can help in some cases. Again, in football it is estimated that seven percent of hospitalized players are injured as the result of striking a fixed obstacle outside the playing field and that 95 percent of such injuries could be prevented by establishing an obstacle-free zone around the playing field.

Much can be done to prevent unnecessary injuries annually suffered by Americans.

## Fluoridation of Community Water Supplies

With tooth decay affecting 95 percent of Americans, it is the most common health problem,

costing an estimated \$2 billion yearly for treatment. Adverse consequences include pain, infection and tooth loss.

Fluoridation is one of the most effective--and cost-effective--preventive measures known. By making teeth less susceptible to decay through increasing resistance to the action of bacteria-produced acid (it may have an antibacterial effect as well), optimal level fluoridation of drinking water can prevent 65 percent of decay that would otherwise occur. And it can do so for 10 to 40 cents per person per year, depending upon the size of the community.

Currently, less than half of Americans have access to fluoridated water. About a third are served by fluoride-deficient community water systems. An additional 35 to 40 million are on individual (noncommunal) water systems with undetermined fluoride content.

Where community water supplies are not fluoridated or where there is no central source of drinking water, as in many rural areas, other means may be used. In some localities, school drinking water is fluoridated--a help in reducing decay but less effective than community-wide fluoridation since it does not reach pre-school children and is not available to any child when school is not in session.

Fluoride mouth rinses are effective but require regular, continued use for maximum benefits. In carefully controlled clinical studies, fluoride rinsing has produced 35 percent decay reduction.

If dietary fluoride supplements are given conscientiously from birth on a daily basis, the protection against decay approaches that of water fluoridation.

Fluoride applied directly to teeth twice a year by a dental professional in a school program or dentist's office also is effective as is daily use of an appropriately formulated fluoride toothpaste.

But none of these approaches is as effective or economical as fluoridated drinking water.

Part of the delay in fluoridation of community water supplies stems from concerns of some groups that it may pose a hazard to health. But substantial research over the past 35 years has produced no evidence to support this concern.

It is important that every community ensure provision of fluoridated drinking water for its citizens.

### Infectious Agent Control

Some 291 million illnesses from infectious disease occurred in the United States in 1975--more than one for every person. Because of them, each year at least 156 million work days are lost and the cost for treatment and lost productivity is estimated at \$24 billion annually.

In a typical year, the Center for Disease Control investigates, upon request, about 1,700 outbreaks of infectious diseases throughout the country.

Most of the deaths and illnesses related to infectious diseases are due to the viral, bacterial and other microbial agents of influenza, pneumonia, the common cold, urinary tract infections, gastroenteritis, hepatitis, childhood infectious diseases, sexually transmissible diseases, tuberculosis, and hospital-acquired infections.

There has been substantial success, as noted earlier, in minimizing the infectious diseases as threats to life. In 1977, only influenza and pneumonia together continued to rank as one of the 10 leading causes of death.

But new diseases appear and even familiar diseases may change periodically, making existing protective measures ineffective.

Legionnaires' disease is an example of a newly identified infection. The emergence of strains of gonococcal bacteria resistant to penicillin, and the periodic shifts in strains and virulence of influenza viruses, are examples of changes in familiar diseases.

These changes demand close monitoring and surveillance of infectious disease incidence.

Surveillance--a basic tactic for disease control--requires four activities.

- finding cases of disease or significant exposures through the efforts of physicians and other health workers;
- reporting cases to a responsible health authority, generally a public health official--traditionally done by physicians, but now also done by schools and industries;
- analyzing and interpreting the reported information to determine its implications; and
- responding appropriately to the interpreted information with measures to control the source of the problem.

Examples of response measures include an immunization campaign in the face of a polio outbreak, closing a restaurant found to be serving contaminated food, and providing substitute water supplies until a polluted source can be purified.

Today, about five percent of all patients admitted to hospitals acquire an infection while there, incurring an added \$1 billion in treatment charges. It is anticipated that stronger surveillance and control techniques now available can reduce incidence of these infections by 20 percent.

The United States has the most sophisticated infectious disease surveillance system in the

world--and it is possible to target surveillance for many conditions--infectious and non-infectious--that are either preventable or amenable to effective intervention.

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In a broad prevention strategy, the concept of health protection must extend beyond traditional disease control measures to include protection against environmental and occupational hazards and reduction of accidental injuries.

These hazards are threats to all Americans, regardless of age, health status, or socioeconomic factors.

Yet many accidents can be prevented, toxic agents can be reduced, occupational safety and health programs can be implemented, community water supplies can be readily fluoridated, and infectious diseases can be effectively controlled and in some cases eliminated.

A commitment to safety and elimination of hazards--by everyone from government officials to parents to children--would save millions of Americans from needless pain and disability.